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TF 2158

DUAL DC POWER SUPPLY

Instruction Manual

Dual DC Power Supply
TF 2158

Code No. 52158-900R

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1979

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

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Note ...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ▶ .... ◀ to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class 1. It has been tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

Fuses

Note that the supply fuse is connected in series with the brown (live) wire of the supply lead. If the equipment is connected to the supply via a two-pin plug, it will be possible for the fuse to become connected to the neutral side depending upon the orientation of the plug in its socket. In these circumstances certain parts of the instrument could remain at supply potential even after the fuse has ruptured.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

Chapter 1

GENERAL INFORMATION

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INTRODUCTION

1. TF 2158 incorporates two independent power supply units each providing 0 to 30 V at 0 to 2 A. The supplies may be used separately, connected in series to give a maximum of 60 V, 2A, or in parallel to give up to 30 V, 4 A.

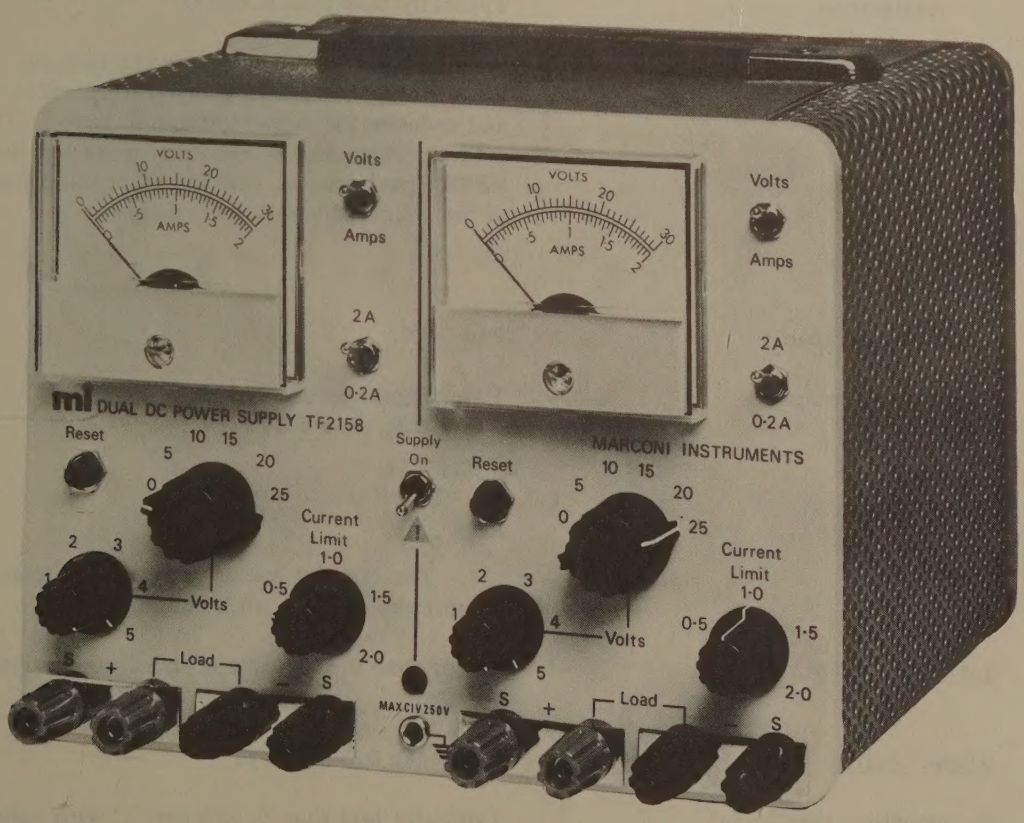

Fig. 1 Dual DC Power Supply TF 2158.

2. Each unit is fully protected against overload and has a meter which provides monitoring of current or voltage. Separate sensing terminals allow for local or remote regulation of supply.

3. To protect circuits supplied by the unit a current limit control may be set to safe limits before switch-on.

4. Output voltage is selected by a six position switch with a range of 0 to 25 V, together with a variable fine control providing a further 0 to 5 V. Output current is controlled in two ranges with a variable control of current limit.

PERFORMANCE DATA

5. The data in paras. 6 to 11 applies to each of the two power supply units.

6. Output

Voltage	0 to 30 V in 6 switched ranges of : 0 to 5 V 5 to 10 V 10 to 15 V 15 to 20 V 20 to 25 V 25 to 30 V with continuous variable control on each range.
Current	0 to 2 A in 2 switched ranges with variable control of current limit.
Resistance	Typically less than 0.005 Ω.

7. Overload protection — When the current rises above the current limit setting the overload circuit operates and reduces the output voltage to zero. The output voltage can be reset by operating the RESET push button, provided that the cause of the overload has been removed.

8. Meter

Voltage range	0 to 30 V.
Current range	Two ranges, switch selected : 0 to 0.2 A, 0 to 2 A.
Accuracy	±2% f.s.d.
	Note ... The current meter range switch also selects the current limit range.

9. Line regulation — Better than 0.01% for a 6% a.c. supply line change.

10. Ripple content — Less than 0.8 mV p-p.

11. Temperature coefficient — Typically less than 0.02% per °C with reference to 23°C.

12.	Safety	Complies with IEC 348.
13.	Radio frequency interference	Conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.
14.	Limit range of operation	
	Temperature	10^{o} to 30^{o}C on full load. 0 to 45^{o}C at 1 A.
15.	Conditions of storage and transport	
	Temperature humidity altitude	-40^{o}C to $+70^{o}$C. Up to 90% relative humidity. Up to 2500 m (pressurized freight at 25 kN/m^2 differential,(i.e. 3.7 lbf/in^2).
16.	Power requirements	
	AC supply	110 V, 120 V, 220 V, 240 V ±6%. 50 to 60 Hz.
17.	Dimensions and weight	Height Width Depth Weight 175 mm 205 mm 200 mm 5.5 kg 6.9 in 8.1 in 7.9 in 12.1 lb.

Chapter 2

INSTALLATION

CONTENTS

Para.
1 Unpacking and repacking
2 Mains supply connector
3 Mains voltage selection

UNPACKING AND REPACKING

1. Retain the container, packing materials and the packing instruction note (if included) in case it is necessary to reship the instrument. If the instrument is to be returned for servicing attach a label indicating the service required, type or model number (on rear label), serial number and your return address.

   If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; If the rear panel has guard plates or other projections a rear load spreader is also advisable. Mark the package FRAGILE to encourage careful handling.

MAINS SUPPLY CONNECTOR

2. A suitable three-pin mains plug must be connected to the captive mains lead. The colour coding of the three wires is as follows :-

BROWN	-	LIVE
BLUE	-	NEUTRAL
GREEN/YELLOW	-	EARTH

MAINS VOLTAGE SELECTION

3. The TF 2158 may be operated from 110 V, 120 V, 220 V or 240 V, 50 to 60 Hz. The mains transformer input connections to match any of these supplies are adjusted by two slider switches on the rear panel. These are marked 110 V/120 V and x1/x2. Set these switches and fit fuse as follows :-

Mains supply available	110 V/120 V	x1/x2	
110 V	110 V	x1	Fit T 3.15 A (anti-surge) fuse
120 V	120 V	x1	
220 V	110 V	x2	Fit T 2 A (anti-surge) fuse
240 V	120 V	x2	

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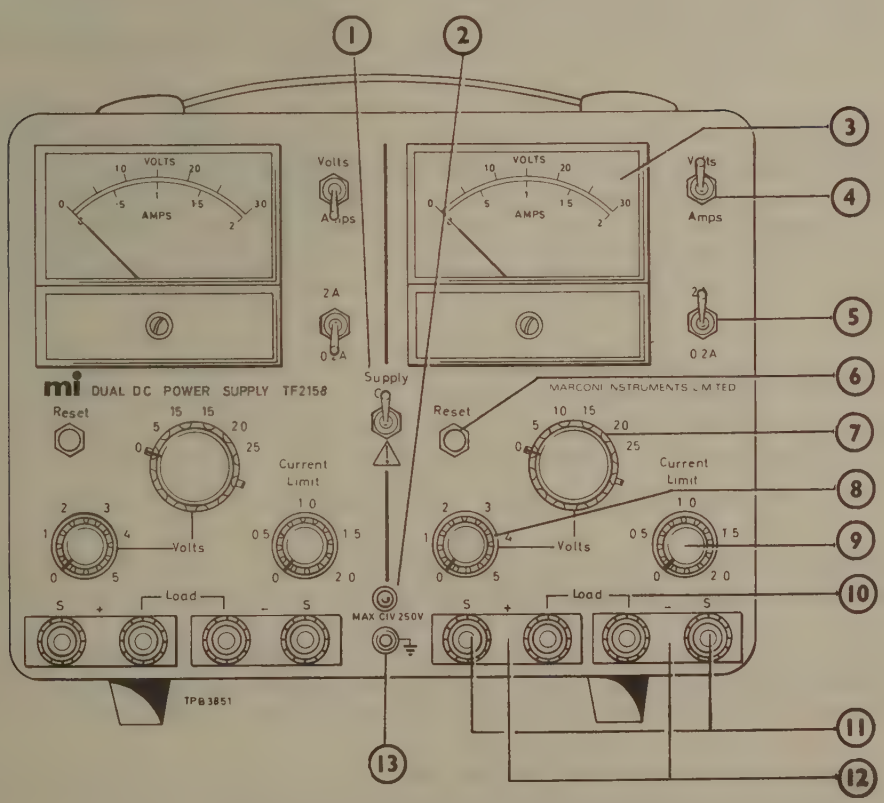

Fig. 1 Front panel controls and connectors.

CONTROLS AND CONNECTORS

1. Controls and connectors on the front panel of the TF 2158 shown in Fig. 1 are as follows :

(1) Mains supply ON/OFF switch for both supply units.
⚠ Hazard warning. The maximum circuit insulation voltage above earth allowed on the output terminals is 250 V and this must not be exceeded.

(2) Mains supply indicator light.

(3) Meter. Monitors voltage between S terminals or current through sensing resistors as selected by (4).

(4) VOLTS/AMPS switch. Selects meter function as voltmeter or ammeter.

(5) 0.2/2 A switch. Selects meter current range and current limit range as 0.2 A or 2 A.

(6) RESET push-button. To reset supply after overload has been removed.

(7) VOLTS switch. Six position switch provides stepped output voltage in the range 0 to 25 V. Used in conjunction with (8).

(8) VOLTS control. Provides continuous control of output voltage in the range 0 to 5 V which adds to voltage provided by VOLTS switch (7).

(9) CURRENT LIMIT control. Determines maximum current that can be drawn from output terminals with range selected by (5).

(10) LOAD + and -. Positive (red) and negative (black) supply output terminals.

(11) S + and -. Positive (red) and negative (black) sensing input terminals. These must be connected to provide either local or remote regulation of supply.

(12) Shorting bars. Used to couple LOAD and sense terminals (as illustrated) for local regulation of supply.

(13) ⏚ Earth socket. Can be connected to either + or - load terminals to determine polarity of output.

2. Controls and connectors listed above, with the exception of mains supply switch and indicator, are duplicated on the front panel for the second supply unit.

3. Mounted on the rear panel is the mains supply fuse and the mains voltage supply selector switches. The voltage positions of 120 V/110 V and multiplier positions of x1/x2 are selected to enable the instrument to operate from 120 V, 110 V with a 3.15 A fuse or 240 V/220 V with a 2 A fuse.

OPERATING PROCEDURE

WARNING

Maximum voltage on the output terminals above earth must not exceed 250 V.

4. To ensure adequate cooling of the heat sinks it is important to maintain free circulation of air especially through the meshed side panels.

5. Before connecting the instrument to the mains supply ensure that the mains voltage selector and multiplier switches on the rear panel are correctly set for the mains supply available. Check also that the correct fuse is fitted, then proceed as follows :-

(1) Select voltage and current limit settings.

(2) Select VOLTS position on meter switch.

(3) Connect the sense terminals for local or remote regulation (see following paras.).

(4) Connect the LOAD terminals to the load for single, series or parallel operation (see following paras.).

(5) Switch instrument on and adjust variable fine voltage control to the required voltage, as indicated on the meter.

(6) Select AMPS position on meter switch and monitor the output current.

6. If a voltage is fed to the supply unit in excess of its own output the current will fall to zero. However, the limit of voltage that can be safely dealt with is determined by the voltage rating of capacitors across the output circuit. Care must be taken to ensure that this voltage does not exceed 35 V.

Local or remote sensing regulation

WARNING

Avoid contact with the sense/load terminal shorting bars even when power supply is switched off as connected load potential could be dangerous.

7. Output terminals are marked LOAD + and -. Alongside these are the sense terminals marked S. For local sensing regulation at the supply terminals, couple the LOAD terminals to the sense terminals with the shorting bars provided.

8. Remote sensing regulation is recommended in high current applications where the voltage drop along the connecting leads may be significant. Remove the shorting bars and connect the sense terminals via two leads to the required points of regulation. For optimum remote sensing regulation the voltage drop along the supply line should not exceed 0.5 V.

9. The sense terminals must be connected in circuit with the load for local or remote regulation. If the supply unit is inadvertently switched on with no connections to the sense terminals the overload protection circuit will operate reducing the output voltage to zero. The meter in the VOLTS position will indicate slightly negative.

Single unit operation

10. The LOAD and sense terminals of the single unit are connected to the load. Controls are set and operated as previously described. The meter monitors the supplied voltage or current.

Series operation

11. A maximum supply of 60 V at 2 A is achieved by operating the two units in series. Connect the positive LOAD terminal of one unit to the negative of the other and connect the remaining negative and positive terminals to the load. Set each unit to provide approximately half of the required voltage. Total voltage supplied is the sum of the two voltmeter readings.

Parallel operation

12. A maximum supply of 30 V at 4 A is achieved by operating the two units in parallel. Connect the two positive LOAD terminals together and the two negative LOAD terminals together. Connect the positive and negative LOAD terminals to the load. Set each unit to provide approximately half of the required current. Total current supplied is the sum of the two ammeter readings.

13. When near maximum current from each unit (2 A) is required, it is necessary to balance the two currents by adjustment of the five VOLTS control. Without this balance a current limit condition is likely to occur and the unit overload circuit will operate. Balancing is made easier by feeding the output from one supply and adding the parallel supply through a low value resistor (0.5 Ω can be sufficient).

Chapter 4

TECHNICAL DESCRIPTION

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8 Circuit description
8 Mains transformer
10 Rectifier and smoothing
15 Output supply and regulator
23 Current limit protection
28 Metering

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1 Simplified block diagram 1

INTRODUCTION

1. The TF 2158 comprises two independent power supplies which share a common mains transformer for provision of the required a.c. voltages. With the exception of this and the mains on indicator, the following descriptions apply to each of the two identical supply circuits.

GENERAL DESCRIPTION

2. The simplified block diagram, Fig. 1, shows the key components involved in the two main functions :-

(1) supply and regulation
(2) short circuit and current limit protection.

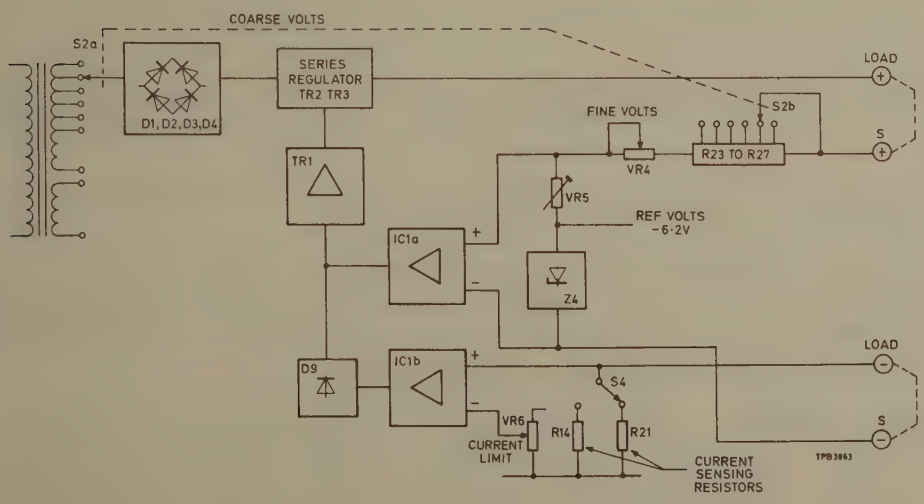

Fig. 1 Simplified block diagram.

3. AC supply is provided by a single mains transformer with two pairs of secondary windings that feed the two supply circuits. One winding of each pair has tappings that are selected to provide a rectified voltage to a series regulator appropriate to the output voltage required.

4. A high performance amplifier, stabilized by a feedback loop, drives a series regulator circuit controlling the output supply.

5. Short circuit protection is provided by a latching bistable operated by the potential developed across load current sensing resistors. This provides a short circuit overload signal to the series regulator and shuts down the supply.

6. The bistable operating point voltage can be varied to provide current limiting within the normal current supply range.

7. A meter switched to indicate voltage or current monitors the output supply. The meter is connected across the two sense terminals to monitor voltage and across the load current sensing resistor in the negative load line to monitor current.

CIRCUIT DESCRIPTION

Circuit diagram, Chap. 7, Fig. 1

Mains transformer

8. The two primary windings of the mains transformer are connected in series for 220 V or 240 V operation or in parallel for 110 V or 120 V operation. This is achieved by voltage selector switch S6 and multiplier switch S7.

9. There are four transformer secondary windings which are brought out in two pairs at each side. Each pair consists of one winding providing approximately 40 V a.c. and a second providing approximately 31 V a.c. with five intermediate voltage tappings.

Rectifier and smoothing

10. AC from the tapped secondary transformer winding is full-wave rectified by D1 to D4 and smoothed by C2. This provides the main power to the series regulator. The a.c. input to D1 to D4 is selected by S2a.

11. C13 suppresses any line interference generated by D1 to D4. R28 discharges C2 when the instrument is switched off.

12. Connected to the lowest voltage tapping is the mains supply ON indicator. This is a front panel mounted l.e.d. which is fed with half-wave rectified a.c. voltage via D5 and R1.

13. AC from the other transformer secondary winding is half-wave rectified and capacitor smoothed to provide +55 V via D7, C1 and -55 V via D6, C3.

14. +5.6 V is obtained from the +55 V line via R2, Z1 which is fed to IC1a and IC1b pins 8. -15 V is obtained from the -55 V line via R3, C4, R4 and Z2. This -15 V provides via R19 and Z3, -5.6 V which is fed to IC1a and IC1b pins 4. The -15 V line also provides, via R35 and Z4, a -6.2 V reference voltage with respect to the -S terminal.

Output supply and regulator

15. The inverting input to IC1a is connected to -S and the non-inverting input is connected to the junction of VR4 and VR5. This junction is maintained at a potential within a few millivolts of -S by means of feedback around the loop consisting of IC1a, TR1, TR2, TR3, R23 to R27, VR4, VR5, R15 and Z4.

16. Since the potential at the junction of VR4/VR5 is the same as that at -S and the potential at Z4 anode is 6.2 V below this, there is a constant current of approximately 1 mA flowing from +S through S2b reaching -S via selected resistors. VR5 sets up this current and S2b (coarse VOLTS) and VR4 (fine VOLTS) determine the potential of +S to produce this current.

17. With this stabilized input condition, control amplifier IC1a via amplifier TR1, drives the series control elements TR2 and TR3 which provide a supply stabilized against load and line changes. With a no load to full load step change, the output supply should recover and be stabilized within 0.01% in less than 15 μs.

18. S2b is ganged with S2a to give a voltage on C2 appropriate to the output voltage required, thereby reducing the dissipation in the series control transistor TR3.

19. Suppression of any h.f. oscillations in the drive circuit to TR3, is achieved by C12, C6 and C7. Capacitors C9 and C10 improve transient performance and also ensure low output impedance to high frequencies. Typical output impedance is 0.2 Ω at 1 MHz.

20. D11 protects against reverse spikes from inductive loads and also against incorrect application when connecting for parallel use. D10 protects the base of TR2 against excessive transient reverse bias.

21. The inputs of IC1a are protected against transient spikes and mis-application of +S and -S by R20, D12 and R7, Z5.

22. D15 and D16 protect against removal of - LOAD connection by diverting the load current that would otherwise flow down the -S line.

Current limit protection

23. Current limit protection is provided by IC1b which is arranged as a latching bistable. The non-inverting input is connected via R9, R10, R11 to the -15 V line. The inverting input is also coupled to the -15 V line via R29, VR6 and R30. VR6 (CURRENT LIMIT) is set for the required current control. In normal operation (i.e. no overload) the output at pin 1 is negative and D9 is reverse biased.

24. Output current from the supply flows through either R14 or R21, R22, VR3 network. These are the current sensing resistors for the 2 A or 0.2 A ranges and are selected by S4.

25. The potential at S4 is coupled via R8 to the non-inverting input of IC1b. If this potential rises above the level determined by VR6, then the non-inverting input of IC1b will become positive with respect to the inverting input and IC1b will latch with positive output at pin 1. D9 will be forward biased causing TR1 to conduct with its collector close to 0 V. Thus without current drive to TR2 and TR3 the supply output will fall to zero.

26. With the overload removed, IC1b is unlatched by operating S5, the front panel RESET push-button. This disconnects IC1b positive output from its non-inverting input line and allows IC1b to revert to normal operation. Thus D9 is again reverse biased and IC1a resumes control of the supply. R34, connected across S5, prevents excessive current flowing if S5 (RESET) is operated with the overload condition still present.

27. C5 protects IC1b by preventing transients on the input circuits causing false current limit operation. Negative transients on +S (e.g. caused by inductive loads) are limited by D13 but passing through D14 will cause IC1b to latch and shut down the supply. R31 prevents an output voltage surge when the instrument is switched off.

Metering

Output voltage

28. A 1 mA f.s.d. meter monitors the output voltage and is connected via S3, R16 and VR1 to the +S and -S terminals. VR1 provides calibration control of the 0 to 30 V meter scale.

Output current

29. The same 1 mA f.s.d. meter, but switched via S3 and S4, monitors the voltage developed across the load current sensing resistors. S3 switches the meter function to 'Amps' with R33 and VR2 in series and S4 switches in the current range resistor.

30. With S4 set to 2 A, VR2 provides calibration control of the 0 to 2 A meter scale with load current flowing through R14.

31. Setting S4 to 0.2 A, load current flows through R21 with VR3 plus R22 in parallel. VR3 calibration control, is adjusted so that the potential at S4 with 200 mA flowing is the same as that developed with 2 A flowing through R14. Thus a 10:1 current ratio is established allowing the meter scale f.s.d. to be read as 2 A or 0.2 A dependent on S4 position.

32. R6 is selected to offset the current flowing through the current sense resistors via S4 so that meter zero is obtained for zero output current.

Chapter 5

MAINTENANCE

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4 Removal of case
5 Dual amplifiers and control circuits p.c.b.
7 Rectifier and smoothing circuits p.c.b.
9 Terminal p.c.b.
11 Realignment procedure
12 Test equipment
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14 Voltage calibration
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2 Component layout : rectifier and smoothing circuits p.c.b. 5/6
3 Component layout : terminal p.c.b. 5/6

INTRODUCTION

1. This chapter contains information for keeping the equipment in good working order and for checking overall performance. Before attempting any maintenance, the information given should be read with reference to the preceding Technical Description chapter.

2. Test procedures described in this chapter may be simplified and of restricted range compared with those that relate to the generally more comprehensive factory test facilities which are necessary to demonstrate complete compliance with the specifications.

3. Performance limits quoted are for guidance and should not be taken as guaranteed performance specifications unless they are also quoted in the performance data in Chap. 1. When making tests to verify that the instrument meets the stated performance limits, allowance must always be made for the uncertainty of the test equipment used.

ACCESS TO SUB-ASSEMBLIES

Removal of case

4. The case is in one section. Remove the four screws at the rear of the instrument and withdraw the chassis from the case.

Dual amplifiers and control circuits p.c.b.

5. This p.c.b. is mounted horizontally on the top of the chassis. It is supported above the mains transformer by three pillars.

6. Access to the track side of the board and to the smoothing capacitors underneath is obtained by removing the three board securing screws. When raising the board away from the pillars take care not to strain or break the wiring connections at the front of the board.

Rectifier and smoothing circuits p.c.b.

7. Each supply has a separate rectifier and smoothing circuit p.c.b. which is mounted at the bottom of its own transistor heat sink assembly. These assemblies are situated on the left and right side of the chassis with the p.c.b.'s on the inside.

8. To reveal the p.c.b. for inspection, stand the chassis upside down and remove the two securing nuts at the top side of the board. When withdrawing the p.c.b. from between the mains transformer and the heat sink assembly, take care not to strain or break the wiring connections to the board.

Terminal p.c.b.

9. The terminal p.c.b. is a long narrow board, mounted immediately behind the front panel at the bottom. It is secured to the ends of the front panel terminal posts ensuring mechanical support and direct electrical connection.

10. Access to the track side of the board is obtained by removing the securing nut at each terminal post. Ease the board away from the terminal posts, taking care not to damage the wiring connections or the l.e.d. which is connected at the middle of the board.

REALIGNMENT PROCEDURE

11. The procedure outlined in this section will also constitute a performance check.

Test equipment

12. The test equipment required to carry out the realignment procedure is as follows :-

Voltmeter	:	DC volts ranges to cover 0 to 35 V. Accuracy better than ±0.5%.
Ammeter	:	DC amps ranges to cover 0 to 2.5 A. Accuracy better than ±0.5%.
Variable resistor	:	Approx. 10 Ω, 3 A.

Preparation

13. Ensure that the instrument is correctly adjusted to the mains supply voltage available and that the appropriate fuse is fitted as detailed in Chap. 2. Withdraw the chassis completely from the case, and mechanically set zero on the meters.

Voltage calibration

14. Set TF 2158 controls as follows :-

(1) Coarse and fine VOLTS to max.

(2) CURRENT LIMIT to max.

(3) VOLTS/AMPS switch to VOLTS.

(4) 2 A/0.2 A switch to 0.2 A.

(5) Couple LOAD and Sense terminals with shorting bars.

(6) Connect test voltmeter to LOAD terminals.

(7) Switch instrument on.

Adjust TF 2158 voltage calibration preset controls as follows :-

(1) Adjust VR5 for an output of 30.5 V as indicated on the test voltmeter.

(2) Adjust fine VOLTS control for an indication of 30.0 V on the test voltmeter.

(3) Adjust VR1 to set the TF 2158 VOLTS indication at 30 mark.

15. Adjust fine VOLTS control for an indication of 25 V on the test voltmeter and check that TF 2158 VOLTS indication is 25 V ±2% of f.s.d. Set coarse VOLTS switch to each of the remaining positions, adjusting fine VOLTS control for indications of 20, 15, 10 and 5 V on the test voltmeter. Check on each position that TF 2158 VOLTS indication is correct within ±2% of f.s.d.

16. Disconnect test voltmeter and set output VOLTS back to 30.

Current calibration

17. Set meter switch to AMPS position with range still at 0.2 A. Check ammeter indication is zero. If necessary select a value for R6 to achieve this.

18. Set up test gear and TF 2158 controls as follows :-

(1) Connect rheostat load and test ammeter in series and connect to LOAD terminals.

(2) Set load to maximum resistance

(3) Set 2 A/0.2 A switch to 2 A.

(4) Set current limit to maximum.

19. Increase load current, monitoring the test ammeter indication. The overload trip circuit should operate between 2.05 A and 2.1 A. If necessary select a value for R8 to achieve this.

20. Set output current to 2.0 A as indicated on the test ammeter and adjust VR2 to set the TF 2158 AMPS indication at mark 2.

21. Reduce output current to zero and switch meter to read 0.2 A. Set output current to 0.2 A as indicated on test ammeter and adjust VR3 to set the TF 2158 AMPS indication at mark 2.

22. To check calibration of current limit control, switch meter to read 2 A and set current limit to 1.0 A. Increase output current and check that overload circuit operates between 0.9 A and 1.1 A. A resistor (approx. 10 kΩ) may be added across VR6 (current limit) to obtain this condition; then recheck current limit operation at maximum setting.

FAULT LOCATION

23. The following information is provided to assist in the location of basic faults within the instrument and should be used in conjunction with the circuit diagram in Chap. 7.

Function check without IC1

24. Removal of IC1, the regulation and current limit amplifier, enables basic checks to be carried out on the remaining circuits. An easy comparison can be made between the serviceable supply and the defective one if both supply unit integrated circuits are removed. Proceed as follows :-

(1) Set mains supply switches S6 and S7 for 240 V mains supply operation.

(2) Remove both integrated circuits from their plug-in bases on the dual amplifier and control p.c.b.

(3) Set voltage output controls S2 and VR4 to zero.

(4) Set meter switches S3 to VOLTS.

(5) Fit shorting bars to LOAD and S terminals as for local regulation.

(6) Connect instrument to a Variac set to 0 V and switch on.

(7) Increase Variac voltage from 0 to 240 V. Both meter readings should rise from 0 to approx. 11 V.

(8) Set Variac voltage down to 100 V.

(9) Advance coarse VOLTS controls S2 in step to maximum. Both meter readings should rise approx. 3 V per step from approx. 3 V to a maximum of approx. 20 V.

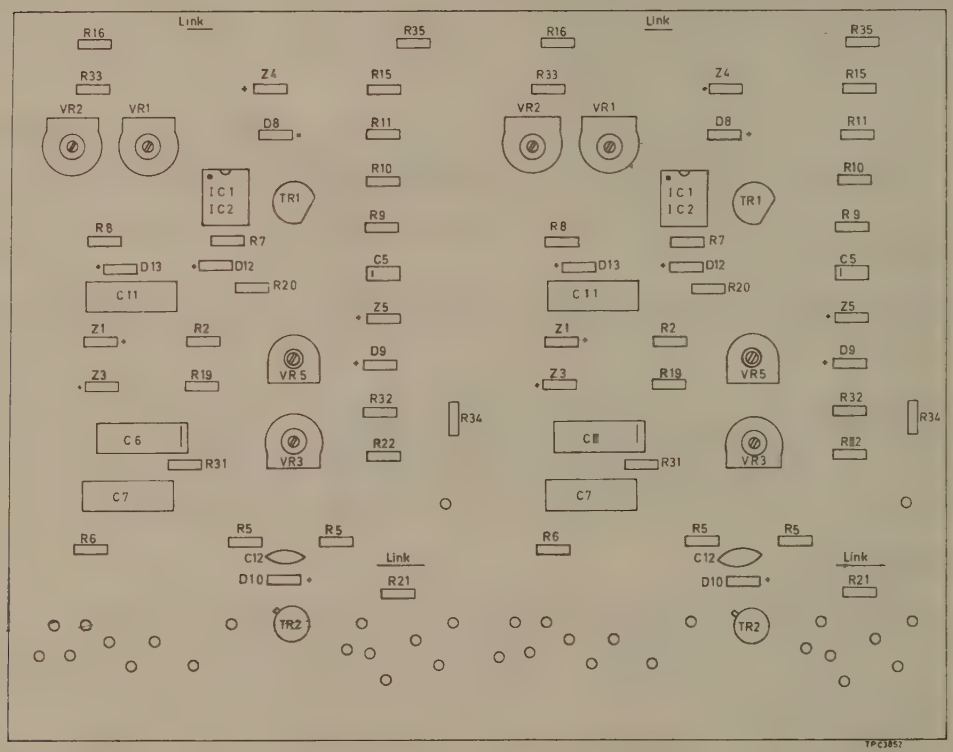

Fig. 1 Component layout : dual amplifiers and control circuits p.c.b.

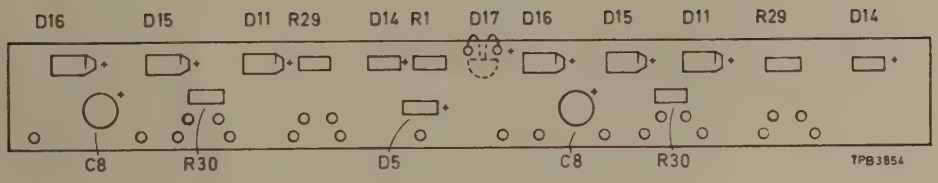

Fig. 2 Component layout : rectifier and smoothing circuits p.c.b.

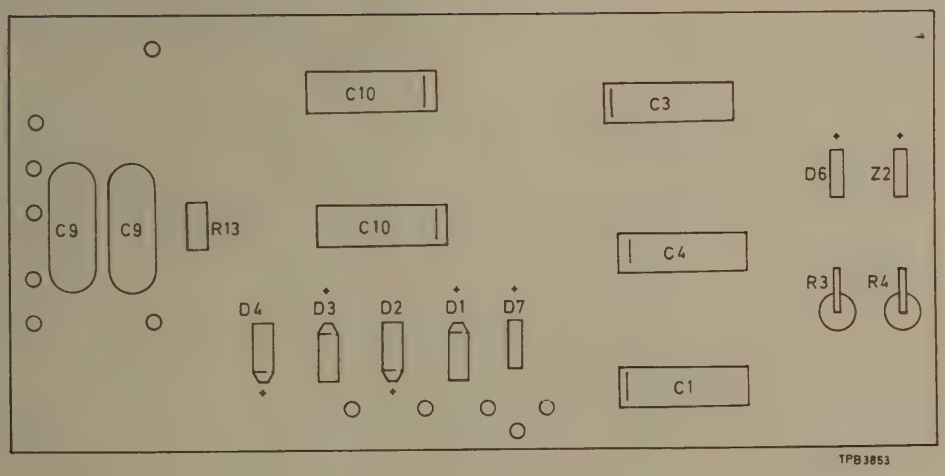

Fig. 3 Component layout : terminal p.c.b.

Chapter 6

REPLACEABLE PARTS

CONTENTS

Para.
1 Abbreviations
2 Component values
3 Ordering
4 Components

ABBREVIATIONS

1. The components are listed in alpha-numerical order of the complete circuit reference and the following abbreviations are used :

C	:	capacitor
D	:	semi conductor diode
Elec	:	electrolytic
FS	:	fuse
IC	:	integrated circuit
M	:	meter
R	:	resistor
S	:	switch
T	:	transformer
TR	:	transistor
VR	:	variable resistor
W	:	wound at 70°C
Z	:	Zener diode
†	:	values selected during test. nominal value listed

COMPONENT VALUES

2. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by a † have their values selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

ORDERING

3. When ordering replacements, address the order to our Service Division (address inside rear cover), or nearest agent and specify the following for each component required :-

(1) Type* and serial number of instrument.

(2) Complete circuit reference.

(3) Description.

(4) MI code number.**

*As given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

**Where only a 5 digit code number is listed, this must be prefixed with TF 2158 FPP/

Circuit reference	Description	MI code
	COMPONENTS	
C1	Elec 100µF 63 V	26002
C2	Elec 2x2200µF 63V	26008
C3	Elec 100µF 63V	26002
C4	Elec 220µF 40V	26003
C5	Elec 6.8µF 40V	26005
C6	Elec 10µF 63V	26006
C7	Cer 0.33µF 250V	26001
C8	Elec 220µF 16V	26004
C9	Cer 2x0.33µF 250V	26001
C10	Elec 2x220µF 40V	26003
C11	Cer 0.33µF 250V	26001
C12	Cer 0.0047µF 100V	26007
D1	1N5401	28355-723N
D2	1N5401	28355-723N
D3	1N5401	28355-723N
D4	1N5401	28355-723N
D5	1N4001	28101
D6	1N4001	28101
D7	1N4001	28101
D8	1N4001	28101
D9	1N4148	28336-676J
D10	1N4001	28101
D11	1N5401	28355-723N

Circuit reference	Description	MI code
D12	1N4148	28336-676J
D13	1N4001	28101
D14	1N4148	28336-676J
D15	1N5401	28355-723N
D16	1N5401	28355-723N
D17	LED (Supply ON)	28103
FS1	2 A anti-surge (220 V, 240 V)	23401
	3.15 A anti-surge (110 V, 120 V)	23402
IC1	MC 1458	28461-320H
M	Meter 1 mA f.s.d.	44501
R1	Met film 330Ω ±5% ¼W	24773-261D
R2	Met film 9.1kΩ ±5% ¼W	24773-296X
R3	Met film 1kΩ ±5% 1W	24001
R4	Met film 1kΩ ±5% 1W	24001
R5	Met film 2x2.2kΩ ±5% ½W	24573-081M
R6 †	Met film 4.7kΩ ±5% ¼W	24773-289W
R7	Met film 10Ω 5% ¼W	24773-225W
R8 †	Met film 15kΩ ±5% ¼W	24773-301P
R9	Met film 18kΩ ±5% ¼W	24773-303M
R10	Met film 18kΩ ±5% ¼W	24773-303M
R11	Met film 18kΩ ±5% ¼W	24773-303M
R13	Met film 10kΩ ±5% 1W	24002

Circuit reference	Description	MI code
	COMPONENTS (continued)	
R14	Wirewound 0.5Ω ±5% 3W	24004
R15	Met ox 4.7kΩ ±5% ½W	24573-089E
R16	Met film 27kΩ ±5% ¼W	24773-307K
R18	Met film 120Ω ±5% ¼W	24773-251L
R19	Met film 2.2kΩ ±5% ¼W	24773-281Y
R20	Met film 2.2kΩ ±5% ¼W	24773-281Y
R21	Met ox 6.8Ω ±5% ½W	24552-016J
R22	Met film 10Ω ±5% ¼W	24773-225W
R23	Met film 4.7Ω ±5% ¼W	24773-289W
R24	Met film 4.7kΩ ±5% ¼W	24773-289W
R25	Met film 4.7kΩ ±5% ¼W	24773-289W
R26	Met film 4.7kΩ ±5% ¼W	24773-289W
R27	Met film 4.7kΩ ±5% ¼W	24773-289W
R28	Wirewound 1.5kΩ ±5% 6W	24003
R29	Met film 27kΩ ±5% ¼W	24773-307K
R30	Met film 56kΩ ±5% ¼W	24773-315U
R31	Met film 4.7kΩ ±5% ½W	24573-089E
R32	Met film 22Ω ±5% ¼W	24773-233M
R33	Met film 1 kΩ ±5% ¼W	24773-273A
R34	Met film 10kΩ ±5% ¼W	24773-297M
R35	Met film 680Ω ±5% ¼W	24773-269K
S1	Mains supply on/off	23101
S2	VOLTS range	23104
S3	VOLTS/AMPS selector	23101
S4	0.2/2A selector	23102
S5	RESET push-button	23103
S6	Voltage selector (120 V/110 V)	23105
S7	Voltage multiplier (x1/x2)	23105
T1	MAINS TRANSFORMER	43101
TR1	ME 4102	28201
TR2	BC 301	28202
TR3	2N 3055	28456-567W
VR1	4.7kΩ	25004
VR2	220Ω	25002
VR3	100Ω	25001
VR4	5kΩ (Fine VOLTS)	25005
VR5	Cermet 2.2kΩ	25003
VR6	5kΩ (CURRENT LIMIT)	25005
Z1	BZY88/C5V6	28102
Z2	BZY88/C15	28104
Z3	BZY88/C5V6	28102
Z4	1N821	28105
Z5	BZY88/C5V6	28102

Chapter 7

CIRCUIT DIAGRAMS

CONTENTS

Para.
1 Circuit notes

Fig. Page
1 TF 2158 Dual d.c. power supply : circuit diagram 3/4

CIRCUIT NOTES

1. Component values

Resistors : No suffix = ohms, k = kilohms
Capacitors : No suffix = microfarads, p = picofarads
SIC : Value selected during test; nominal value shown.

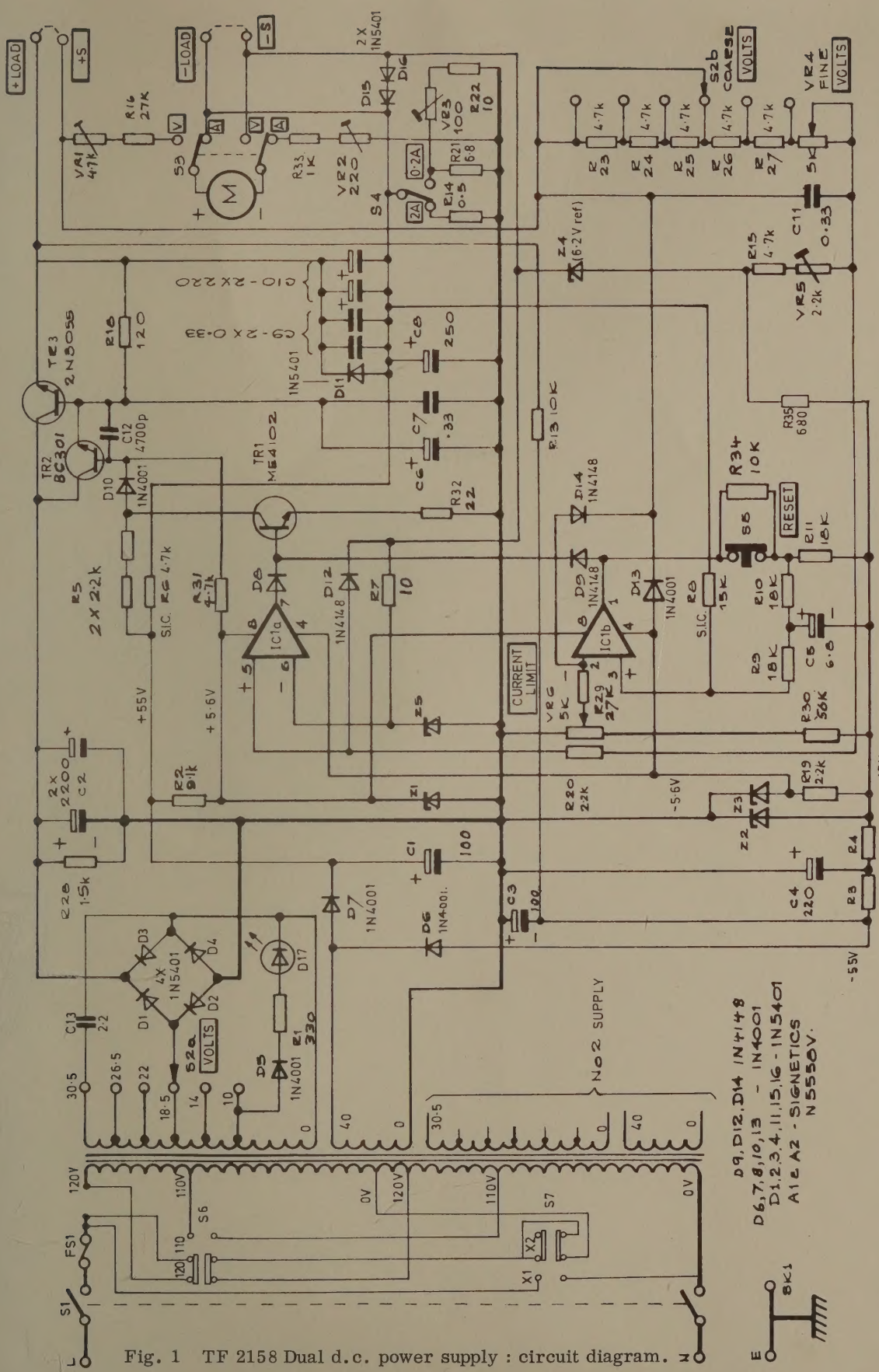

Fig. 1 TF 2158 Dual d.c. power supply : circuit diagram.

TF 2158

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